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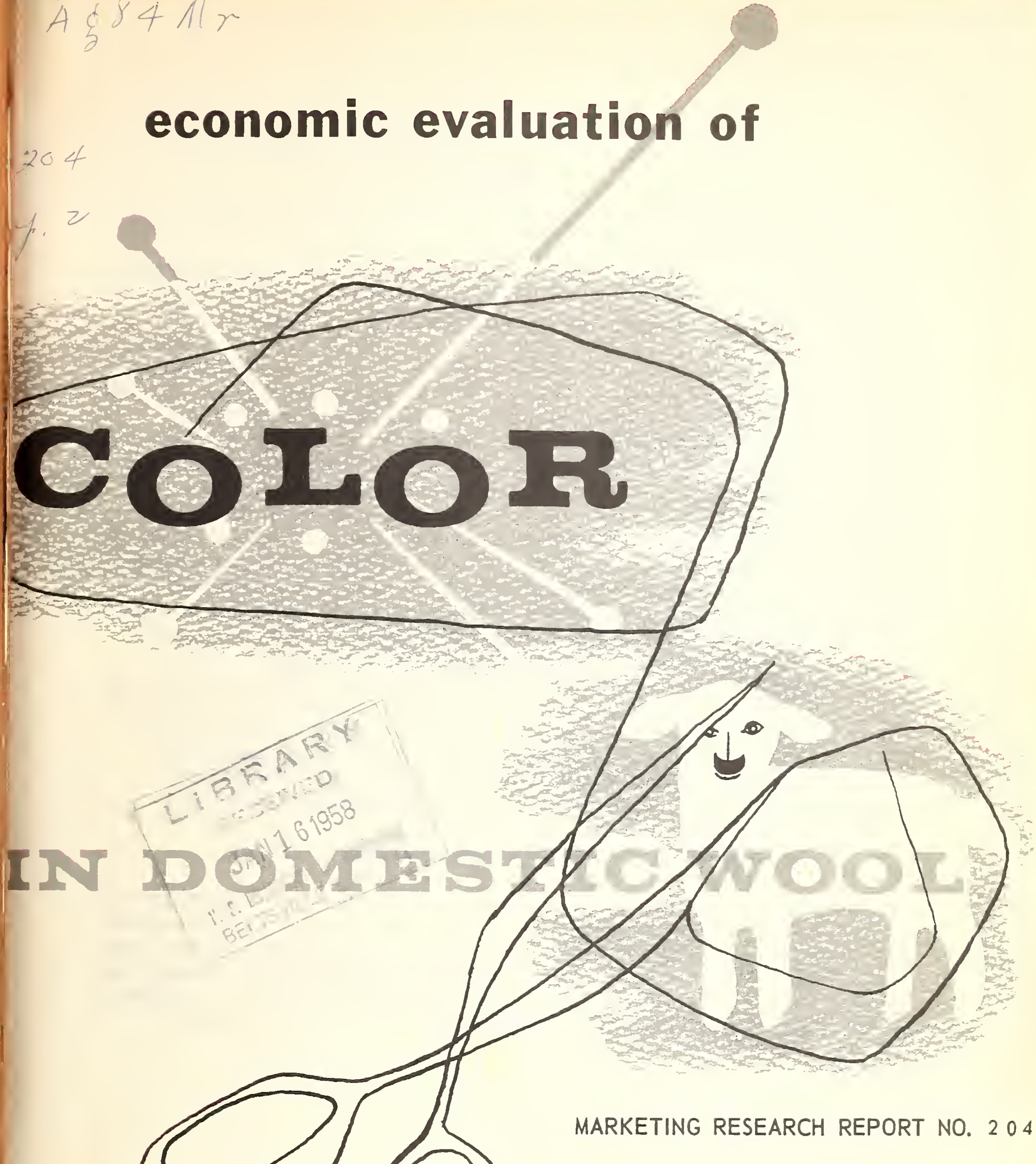
economic evaluation of COLOR IN DOMESTIC WOOL



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MARKETING RESEARCH REPORT NO. 204

U. S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE
MARKETING RESEARCH DIVISION

WASHINGTON, D. C.

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Personnel of the Livestock Division Wool Laboratory, Denver, Colo., under Dr. Elroy M. Pohle, collected and processed samples of domestic wools for the color analysis.

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ECONOMIC EVALUATION OF COLOR IN DOMESTIC WOOL

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Research Division, and Willie Fong, chemist, Western
Utilization Research and Development Division

SUMMARY

Color in wool, as evaluated by this study, is the nonscourable discoloration of otherwise white wool fibers. It does not include heavily pigmented fibers which grew in their colored form on the sheep. Color in wool is attributed to many sources; the major ones are urine and fecal material, minerals and vegetables, and bacteria and fungi. Heat and contaminants produce discoloration as well as other harmful effects on the fibers of shorn greasy or scoured wool.

Discounts for color in wool were determined through the use of a color-scale model based on the colors found in a cross section of domestic wools. This model, or comparator, method was developed to eliminate all factors except color from the value judgment obtained from processors of wool. Fifty firms, whose 123 wool-processing establishments are estimated to process more than half the wool produced in the United States, participated in the survey.

Color of wool in sample or lot was found to be an important first impression factor to buyers. Buying on sample is a prevalent practice and all respondents associated color with lower value and a source of discounting of price, although the discount was not specific enough to define with certainty. The importance of style of apparel and recent trends toward white and pastel shades in wool garments were cited as major reasons for greater emphasis on color discounting of wool.

Using the color comparator, each respondent gave an opinion on the discount associated with each grade of wool used by his firm for each color shown by the color scale. "A," the lightest color shown, was used as a base reference. The average discount in price for wool of color "C" was 3.3 percent under color "A" for fine wool (64's and finer), 3.5 percent for medium wool (56's through 62's), and 3.7 percent for 1/4 blood wools (46's through 54's). Color "E" was discounted from color "A" by 6.9 percent for fine wools, 7.4 percent for medium wools, and 6.8 percent for 1/4 blood wools.

Intermediate product processor groups found color to be more of a problem than integrated mills and final product processors because of their need to produce a product for further processing that would compete with

similar products from other processors. Color is a strong point in selling undyed wool intermediate products and these processors tended to discount more heavily for color than integrated mills who process greasy or scoured wool into fabric or garments, exercising control over the raw material placement and use all the way to the finished product.

Color affects the types of uses and amount of wool that can be used for various products. It was found that wool of color "A" was useful for 91.1 percent of products made in the previous 12-month period by all firms visited. Color "B" could be used to make 73.7 percent of the volume of products made, color "C" was suited for 56.9 percent, color "D" for 35.5 percent, and color "E" for only 32.6 percent. Extent of utility of colored wools ranged widely between firms and types of uses; for example, wool of color "A" ranged from 30 to 100 percent of individual firm's total product; "B" had a range of 25 to 100 percent for individual firms; "C" ranged from 0 to 95 percent; "D" from 0 to 90 percent; and "E" from 0 to 70 percent.

Color as a quality characteristic ranked third in relative importance of different factors affecting a wool buyer's appraisal of quality of a sample or lot. Fineness (fiber diameter) ranked first, uniformity of fiber length ranked second, and color, along with black fiber, vegetable matter, and mechanical defects, ranked third. Crimpiness received a numerical average rank of 4.9 and last among factors used in value judgment of wool by buyers.

Expanding markets for colored wool, or reducing the amount of wool discounted for color may be sought in several ways. Processors are now segregating and designating colored wools to uses where their color is not a disadvantage, and the discounts for color found by this study are largely a reflection of the costs of this procedure. A second alternative is chemical modification to remove color. Cost of this process has to conform to or be less than the present discount to be economically feasible, but it may offer a broader use for colored wools.

The third alternative is with the producer himself. If he can upgrade wool for color by improved breeding and husbandry practices, and better handling of clipped fleeces prior to shipment, then the gains, if any, will accrue to him. This is the approach used in other wool-growing countries.

PART I

EVALUATION OF COLOR IN WOOL

INTRODUCTION

The purpose of this report is to give to producers and processors of wool the results of research investigations on nonscourable color in wool. The work was undertaken to resolve questions of economic and physical properties pertaining to off-color in domestic wool.

Producers and processors of domestic wool have found color of wool to be a market factor, but one which was not mutually understood and agreed on in wool marketing circles. Grade standards for wool consider directly only the median fiber diameter of wool and the staple length. Color is one of several other quality factors contributory to the buyers' judgment of the value and therefore the bid price for producers' wool. It is a major point of distinction between wools from the same breed of sheep produced in different geographic and climatic areas of the United States and under different methods of husbandry, such as range, feeding pen, and farm flock.

Efforts in this research were devoted to the objective measurement of degrees of color defect found in a cross section of domestic wool and to evaluate the economic effects, primarily marketability and price differentials, associated with these varying intensities of color in wool found by the physical measurements.

The association in the market place of color in wool with other quality aspects not determined in the usual grading procedure required an approach to the problem using a model in which all qualities of wools except color were made equal. In the actual marketing of wool, if the grade, staple, and color of wools from different sources, either area or method of sheep husbandry, are equal, their prices in the market place will not necessarily be equal. This is because other ungraded characteristic differences such as the growing area will influence the buyer's judgment and acceptance of the two wools.

The Commodity Credit Corporation became the buyer of virtually all the domestic wool clip in 1946. Color was one of the quality factors used in determination of prices to be paid for producer's wool. On the basis of a summary of Commodity Credit Corporation purchases published in The Domestic Wool Clip, Grades, Shrinkages, and Related Data, U. S. Department of Agriculture, June 9, 1951, an indication of the magnitude of the color problem that existed at that time from the standpoint of the total domestic clip may be obtained. (These data are presented in the Appendix to this report.)

This determination has been made on the basis of clip for a single year, and since the extent of discoloration will vary in different years depending on the weather and husbandry practices of producers and handling practices of warehousemen and dealers the data do not provide a measure of average conditions from year to year.

Another important objective of this study of color in wool was to give necessary information for evaluation of new or different methods of color removal. Costs of new color removing reagents and processing techniques must necessarily conform to or be less than the gain derived from the improvement by color removal. Prior to this study, no objective measure of the economic importance of color in domestic wool had been made.

Greater knowledge was needed concerning the market uses and application of colored wools in order to guide the Department's efforts toward expanded markets and increased production of domestic wool. Wool production expansion contemplated in the National Wool Act of 1954 will draw on areas of production where colored wools occur most frequently. To produce and market wool profitably in greater quantities from these areas will require market development activity geared to the processing and expanded use of larger volumes of colored wool in the domestic wool apparel and industrial use-nonapparel markets.

METHODS AND PROCEDURES

The problem of determining premiums and discounts associated with nonscourable color in wool was handled in the following manner:

First, samples of lots of Commodity Credit Corporation wool processed for the Department's grades and standards evaluation and improvement research were evaluated for color reflectance values by the Gardner Colorimeter. (See section II of this report on wool color analysis.) From these color values, a simple color comparator (fig. 1) was developed which depicted the five color groups determined by the color analysis. This comparator permitted a direct comparison of unknown color value samples of wool to the five colors of wools in the comparator.

Second, a questionnaire was developed which was designed to be used in conjunction with the color comparator in interviews with wool industry members. The interpretive nature of responses to questions on color required a personal interview with each respondent. These responses were analyzed to obtain views of the respondents as a whole on the questions of discounts and premiums for color. Wherever responses of smaller groups, such as topmakers, scourers, woolen and worsted fabricators, were different with respect to the whole, they were considered separately, as well as in combination with industry viewpoint, to give greater perspective.

Since the personal interview elicited information on related marketing problems believed to be important to persons in the wool-producing and marketing enterprise, a part of the report is devoted to comments of persons interviewed. Pigmented fiber, regional color characteristics of domestic wool, and domestic versus foreign wool color were commented upon most frequently.

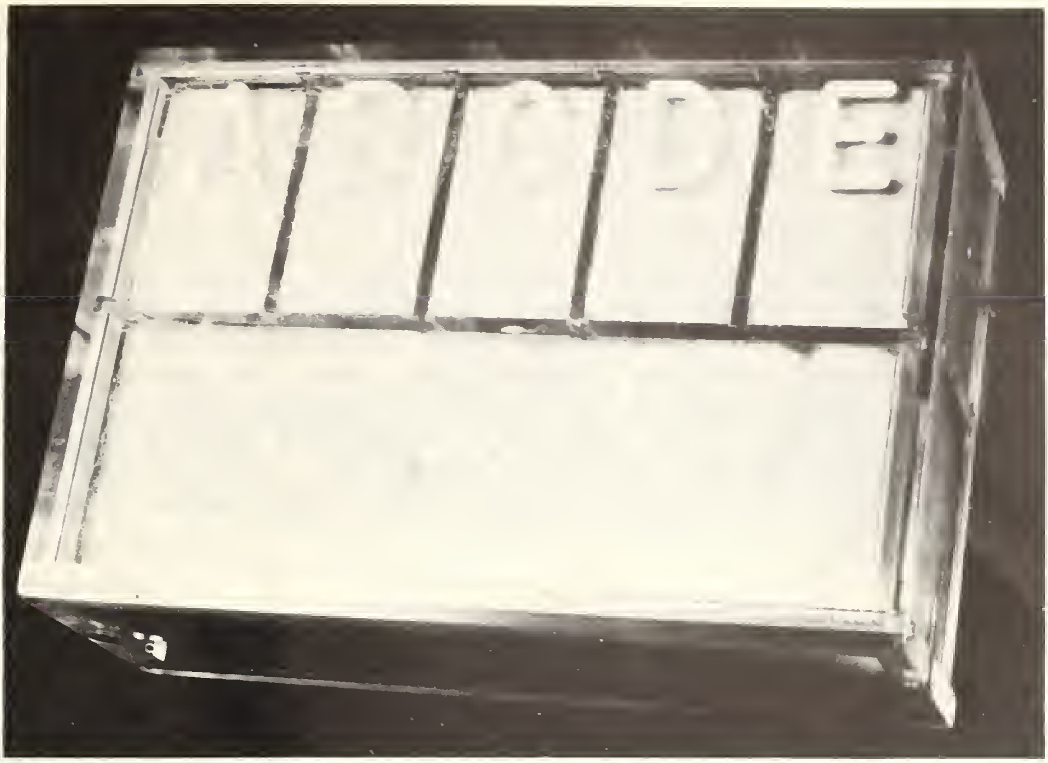

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Figure 1.--Wool color comparator. Blocks A through E are the five color groups representative of color in a cross section of domestic wool. The section below holds a wool sample to be compared with the five color groups.

Description of Sample

Information was obtained from 51 firms in the wool processing industry. Ten of the firms (topmakers) converted greasy or scoured wool to top; 5 firms (wool dealers) converted grease wool to scoured wool; 7 firms converted greasy, scoured, or top wool to woolen or worsted yarn; 2 firms specialized in bleaching--one on commission and one for its own product; 11 firms made woolen and worsted fabrics or garments from scoured, carded, or yarn products; and 10 firms performed all operations from grease wool to fabric. (These firms are classed as either partially or fully integrated, since most of them sell intermediate products as well as fabrics or finished apparel and consumer goods.) Also, 6 firms making specialties such as felts for apparel and industrial use, baby goods, novelty products, wool and hair blend products, reused wool products, and wool and other fiber blend products were included in the sample. All lines of apparel goods were represented in these manufacturers' groups.

Contacts with industry were designed to include both large and small operations, but were limited to those doing a major portion of their business for their own accounts; that is, those who bought their wool and resold the resultant product to other processors or to jobbers and wholesalers. Contacts with topmakers and integrated firms in the worsted apparel division gave representation of much more than half the wool used for these purposes. Representation by volume in the woolen apparel division is not estimable, since there is no dominant group of firms to this division such as the topmakers are in the worsted division. All firms with 7 or more sets of wool cards in the States of Pennsylvania, New York, Massachusetts, Rhode Island, and New Hampshire were visited; however, those firms associated with group wool buying and product marketing organizations, where the buying and selling was done by an agency outside the firm, were omitted wherever this characteristic was known. Total contacts of firms gave reports from 123 establishments performing wool processing operations. It is estimated that about 50 percent of the wool processing business is represented by these 123 establishments.

ECONOMIC APPRAISAL OF EFFECT OF COLOR DEFECTS ON MARKETING DOMESTIC WOOL

Interviews with members of the wool industry indicate that color in wool is undesirable from the standpoint of its effect on marketing, processing, and making of apparel. Styles and fabric designs in greatest demand by today's consumers can best be achieved from white wool. Those with bright, pure colors, especially pastel shades, contrasting weaves, and sharply defined color patterns, require a white, readily dyeable wool. Off-white wool tends to make dye colors dull and lacking in pure tone. In a fabric construction of white and contrasting color, such as tweed, for example, an off-white wool produces a gray effect to the white component and is therefore not desirable. It is difficult to dye material made with off-white wool to match material made with white wool, unless the final color is very dark, and other than blue or green.

Buying and Selling Practices

In preparing wool for making up large orders of match-dyed products, the various lots of wool to be used are sorted by fleeces and blended before processing. Fleeces containing too much color are rejected. If the wool was purchased by the mill on the basis of a sample from the seller with an option to reject a portion of each lot on the basis of nonconformity to the sample, rejected wool is then pushed back into available supply channels and adds to the amount of color-defect wool seeking a market outlet.

All of the wool processors interviewed who sell intermediate wool products (scoured wool dealers, topmakers, yarn spinners, and gray goods manufacturers) report color in wool presents difficulties in making and marketing their product for resale to other processors.

Replies to interview questions indicate that lower value is not generally associated with off-white wool if a buyer is purchasing materials for a darkdyed product, but if offered both white and off-white lots simultaneously he will choose the white if other qualities of the wool are equal, or will seek to buy the off-white product at a lower price per unit than the white. Therefore, trade practice is to offer off-white lots along with lots that are not comparable, with regard to source, fineness, staple, etc. If the off-white characteristic offers no problem to the buyer and the other qualities and characteristics are suited to his uses, a price without a discount for color can frequently be realized.

Buying and selling of wool intermediate products on sample basis, with sales representatives making calls on buyers with samples of each lot offered, makes selling of off-white wool without discounts possible. The costs of such a marketing system and the slower and more difficult placement of sales of off-white wool products make them less desirable from the raw wool buyer's standpoint, even though he may eventually realize a price that is not at a discount for the product.

Discount for Colored Wool

Industry representatives pointed out that a discount, if any, depended upon the market and style situation of the moment. If white wool is plentiful, off-white wools are discounted. The same would be true if white and pastel-dyed goods were the style motifs at the moment. In every discussion with processors, color was a "talking point" in merchandising, and although the discount situation was not specific enough to describe with certainty, the existence of color discounts and premiums was not denied by any person interviewed.

Discussion of economic factors presented by color in wool, from the standpoint of the processor, revolved around the problems associated with use of domestic wool. As described by the processor group, domestic wool lacks homogeneity in every aspect except fiber diameter. Wool lots may contain a broad range of color by individual fleeces and the processor must sort these more highly colored fleeces out before processing the lot. Sorting and removal of fleeces for nonscourable paints and branding fluids, for fleece baling strings, for those fleeces that are very burry or dungy, for fleeces containing a large amount of black fiber, for fleeces of substandard staple, and for those of cotted and murrain wool occur at the same time. Costs of sorting and the lower value of wools sorted from the lot all contribute to the wool buyers' attitude with regard to discounting of wool for color. Also, some buyers discussed color discounts as a major source of differences in price between the Southern wools, fleece wools, Texas wools, and territory wools. In every instance where color differences and discounts in a geographic basis were mentioned, other qualities attributable to wools from each area were also included. Comments heard frequently were (1) fleece wools are more colored than territory wools but are loftier and give a better bodied yarn, and (2) Texas wools are not generally so white as Wyoming wools, but are excellent for felting and for jersey-type woolens.

Thus, wool from each source has a "bundle" of characteristics. Wool from no one area is outstanding in all attributes. The use to be made of the particular wool is a factor in measuring the importance of all characteristics, including color. Measurement of economic differences attributable to color alone by observing prices obtained for lots of wool would be virtually impossible on account of the lack of homogeneity of other unstandardized quality characteristics which also affect price.

Average discounts associated with increasing color in wool were obtained by the use of the color comparator in interviews with buyers and sellers of wool in the sample firms. Each respondent was asked his opinion on the discount of the varying degrees of color shown by the comparator if wools alike in all aspects except color were being bought or sold. The question applied only to the types of wool normally used in processing operations of the firm.

The color reference scale is shown in figure 2. With "A," the lightest color, used as a base reference, the average discount for "C" color in fine wools (64's and finer) was 3.3 percent; for "E" color, 6.9 percent. 1/ Medium wools (56's through 62's) average slightly higher discounts, 3.5 percent under "A" for "C" color type and 7.4 percent under "A" for "E" color type. Quarter-blood wools (46's through 54's) were reported less frequently than the fine and medium wools and color was not as significant a factor to many uses to which these grades of wools are applied. Respondents' average discounts for quarter-blood wools for color were 3.7 percent discount under "A" for "C" color type and 6.8 percent discount under "A" for "E" color type.

Group averages for topmakers, integrated process mills, wool dealers who scour wool for their own account, and yarn makers were different from the industry average and reflect the ability of respondents in each group to cope with the color problem.

In the topmaker group, less than half of the respondents used wools in the 1/4 blood grades. Those who used all grades regarded color as a much less important factor affecting price in the 1/4 blood grades than in the fine wool grades. Products from wool tops in the 1/4 blood grades were such that color was not considered. If a whiter wool top for these grades, comparable to "A" color on the scale was requested, however, a premium equal to that cited as a discount for "E" color would be asked.

Wool scourer-dealers likewise expressed their discount position on 1/4 blood grades as really a premium for whiteness, and the average discount in prices expected for sales of scoured wool was greater than for topmakers interviewed. 2/

1/ Buyers sometimes associated color "A" with a "good territory color"; "C" was called "fleece-type" or creamy Texas; "E" was associated with dark colored Middle Atlantic States and Southern States wools. These are not accurate descriptions, however, and the letter designations are adhered to in this report.

2/ Scourer dealers spoke generally of discounts expected on scoured wool they sold. Topmakers generally spoke of discounts they would expect to get on wool purchased for topmaking.

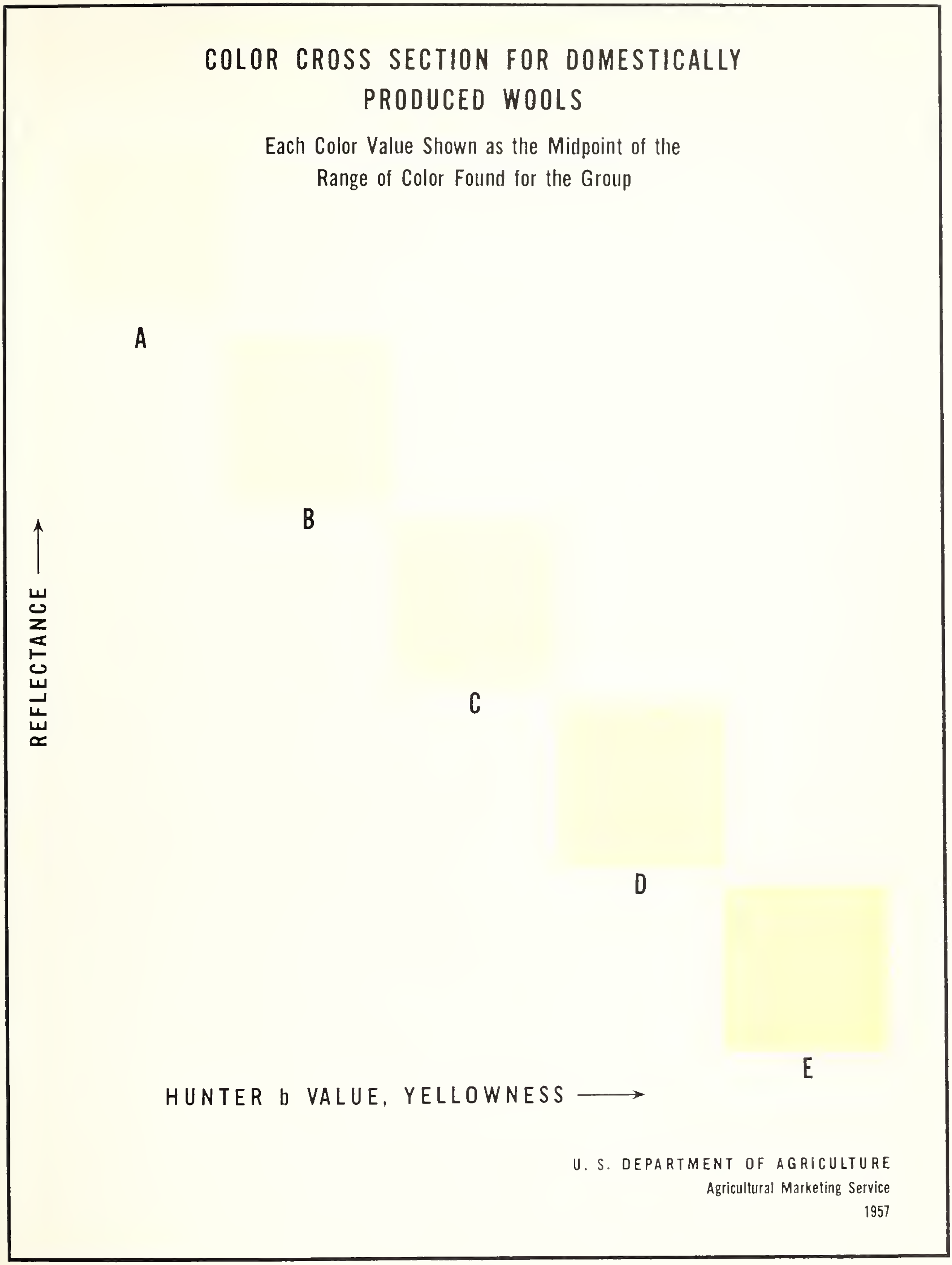
COLOR CROSS SECTION FOR DOMESTICALLY PRODUCED WOOLS
Each Color Value Shown as the Midpoint of the Range of Color Found for the Group
A
B
C
D
E
REFLECTANCE →
HUNTER b VALUE, YELLOWNESS →
U. S. DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
1957

Figure 2

Table 1.--Average price discounts made by the wool industry for color in wool 1/

Respondent group	Number of firms	Discount using color "A" as base reference					
		Fine wools		Medium wools		1/4 blood wools	
		Color "C"	Color "E"	Color "C"	Color "E"	Color "C"	Color "E"
		Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Topmakers	10	2.3	5.0	1.9	4.2	1.8	3.9
Dealers who scour wool	5	4.4	8.7	4.0	9.0	4.8	11.0
Integrated process mills	10	3.9	8.0	3.7	7.7	3.2	5.7
Yarn mills	7	2.5	6.0	5.2	12.3	8.0	11.5
Industry average	50	3.3	6.9	3.5	7.4	3.7	6.8

1/ "B" and "D" colors of the comparator were omitted from questions on discount when it was found that respondents preferred to express their opinions of prevailing discounts for "C" and "E" colors only.

Yarn-making wool buyers interviewed generally viewed whiteness of yarn product as a premium-producing quality. As a group, they reported colored domestic wools to be heavily discounted under foreign white wools and the whitest domestic wools for this reason. Yarn makers who specialized in worsted and woolen yarns for women's sweaters, baby goods, and wool and hair blend yarns did not feel the color scale used in the study extended far enough into the color range of extra whiteness to include most of the wool they used. Two yarn-making firms visited were unable to give answers to questions about color because the wools they used were above the scale of whiteness shown by the comparator.

SOURCES OF COLOR IN WOOL AND THEIR EFFECTS UPON FURTHER PROCESSING AND USAGE

The type of discoloration had a bearing on the manufacturer's attitude toward color. If the discoloration consisted of sunburned tips, usually yellow to brown, and most of the staple length was white, the discount was not so great as for other discolorations because most of the tip color would disappear in carding and combing, either through breaking off or by blending in with the rest of the fibers to become unnoticeable. Canary yellow color is more of a problem. It is a bright color, usually in large patches extending practically the full length of the fibers. When the locks are carded, combed, and blended together, the sliver or the top has a tinge of yellowness throughout. The intensity of color depends upon the proportion of yellow-lock wool to the whole fleece. Bleaching is the usual method of lightening discolorations of this nature.

Bleaching is a cost item of wool processing that is fully chargeable to color. Also the costs of bleaching are not the full extent of difference in colored and white wool as a processing cost. When wool is bleached, it deteriorates. If the bleach action is very mild, of short duration, and closely controlled, the damage will not be noticeable, but if a strong bleach with long soaking is required, the quality of the wool from the standpoint of resilience, harshness of feel, and processing capability is altered so much that very little, if any, greater price per pound can be obtained for it than if it had not been bleached. Most processors objected to strong bleaches, but felt that a mild bleach could be tolerated in most of the wools used except those for knitting yarns and felts. Thus, a colored wool, whitened by present processing methods, can never equal a naturally white wool in value.

Two other points regarding the reasons for discounting wool for its color quality were mentioned by processors. One is that bleaching reduces the weight of wool. In so-called "full-bleach" treatment, the loss in weight may be as high as 1 percent and can be an important source of loss to the processor if his margin is narrow. The second is that color in wool may be an indicator of other defects; some processors said that color is an index of the general care given to the sheep and to the wool fleece after it is clipped. If the color is poor, it is indicative of fiber weakness, poorer spinning quality, and harsher feel than another wool from the same producing area that is of the level of whiteness generally expected of the area.

Discoloration of wool while in storage is believed by processors to be caused by 2 major factors. If the fleece is moist when clipped and not dried out before tying and packing, heat, moisture, and bacterial action combined produce a discoloration that permeates the entire fiber and fleece. It is difficult to remove and is reported to affect the quality of the wool for apparel uses more than any other form of discoloration. The second factor is the action of yolk, suint, and grease on the wool. Some area wools, and sometimes individual fleeces from the same flock, vary considerably in the nature of materials contained in them. The causes of change were not known, but some domestic area wools are more subject to this form of discoloration than wools from other countries. Fleeces from sheep that are grazed, housed, and penned with other livestock are believed to be the most troublesome. Processors who mentioned this factor of discoloration feel the discoloration could be greatly reduced if scouring could be done soon after the wool is clipped.

The Market for Colored Wools in Apparel Uses

Present buying and selling practices and the degree of specialization among processors tend to emphasize the importance of color defects in wool. Buying and selling practices emphasize the visual qualities of lots of wool by extensive use of samples for buyer appraisal. Wool buyers contacted in the survey indicated color of wool to be an important "first impression" feature, when examining samples or whole lots of wool.

"Full-line" integrated processing firms in the wool industry can, due to their diversity of end-products and control of raw materials flowing through processing channels to different types and colors of end products, use wools containing practically the full range of color variation. This is not generally true of the specialized processing firm, such as the yarn spinner, topmaker, or knit goods processor, and those who make premium-priced wool and animal hair blends. Product markets for the outturn of these firms are limited, since another specialized textile process firm is the usual customer, except for hand knitting yarns. To sell, the quality must meet competition, and color of the product is emphasized. Also, specialization, with exceptional experience and emphasis on the narrower range of processing operations makes these firms seek to sell in the premium class of wool product. In this industry group, firms have tended to specialize in wools from a single source or type. Color has usually been a primary factor in the choice of a particular source of raw material supply.

The apparel consumer, as the primary end user, is the major force in the domestic wool market. Their preferences for styles, colors, weaves, and fibers are factors in the demand for various types of domestic wool. Emphasis upon pastel shades and worsted weaves will particularly affect the demand for white wools; pastel shades because they require a white wool for a starting material; and worsteds because the lag between raw wool and finished fabric product is usually of several months duration and processors are unwilling to risk their effort upon a worsted product of poor color quality when the time between wool buying and fabric marketing is longer than the time usually required for color style changes in the consumer market.

Apparel uses of wool are currently about equally divided between male and female attire and also about equal as to woolen and worsted systems of processing. These ratios change from year to year, however, and the changes create shifts in demand for various types and qualities of wools. A style trend to longer, full skirts of woolen rather than worsted construction for women such as occurred in 1947-48 can alter the ratio to an extent that some wools and wool processing facilities will be overtaxed, while others not usable for the style and process of the season will be in over supply.

The amount of colored wool that can be used by the apparel industry depends upon the style and fabric color in demand by consumers. It is a continually changing market pattern affected by the overall market behavior for all textiles. Men's, boys', and women's outerwear are considered the more stable segments of the apparel industry's uses of wool from the standpoint of color. Dark-dyed fabrics in these uses are the major outlet for colored domestic wools.

In white and pastel-dyed fabrics of wool construction, the whitest domestic wools and foreign white wools are the dominant raw materials. In these uses, the problem of black pigmented fibers becomes very significant. Wool buyers report that black-fiber-free wools are essential to production of white and very light pastel shades. In these, black fiber is very apparent in the finished product and must be removed by costly hand picking.

Bleaching that may be used is very mild and requires a very white starting material. The lightest shade shown by the color comparator contained too much yellow and gray color to be suitable for white and lightly pastel-dyed products according to several wool buyers whose firms made these products.

Each interviewee was asked to express his opinion regarding the opportunity to produce his firm's products with each of the 5 degrees of color shown by the comparator. Answers were expressed in terms of the percentage of total wool products made during the previous year that could have been made if the wool available was all of the color shown by each of the color levels.

Table 2 shows the average of responses of all firms interviewed and the averages for the 4 major respondent groups.

Table 2.--Portion of total apparel wool products made in previous 12-month period that could have been made with wools containing specified levels of color

Respondent group	Reported percentages of total product which could be made by--				
	Color "A"	Color "B"	Color "C"	Color "D"	Color "E"
	Percent	Percent	Percent	Percent	Percent
All firms:					
Average	91.1	73.7	56.9	35.5	32.6
Range	30-100	25-100	0-95	0-90	0-70
Topmakers:					
Average	93.9	83.6	53.3	10.0	8.8
Range	50-100	25-100	0-95	0-30	0-20
Scourers:					
Average	100	87.5	72.5	52.5	40.0
Range	100	85-90	65-90	40-90	20-70
Woolen and worsted manufacturers:					
Average	91.5	80.8	67.3	56.4	54.1
Range	30-100	25-100	20-90	0-80	0-60
Yarn mills:					
Average	96.0	62.0	44.0	22.0	19.0
Range	90-100	30-100	30-80	0-50	0-30

As color in wool increased, the portion of product that could have been made was decreased sharply (table 2). This is observed both in the industry average and the averages for the four selected processor groups. The ranges of percentages reflect the abilities of individual processors composing the average to use colored wool in their products.

The industry average indicates that the whitest domestic wool color shown by the comparator could have been used in 91 percent of total output of apparel wool products made by contacted firms. To individual firms reporting to the survey, it could have filled somewhere between 30 percent and 100 percent of their raw material needs. Color equal to "B" would have satisfied nearly three-fourths of the market but to individuals its utility ranged from 25 percent to 100 percent of product requirements for color. As color increased beyond this point the market opportunity was rapidly lowered. Wool of "E" color was considered eligible for uses in the apparel market equal to less than a third of the requirements. As shown by the range of 0 to 70 percent, some processors would have completely rejected such a wool on the basis of its color.

Topmakers and yarn mills showed the lowest capability for use of wools if colors are equal to "D" and "E." Their products are intermediate in nature, generally sold undyed to other wool processors and the "first-sight" appeal aspect of whiteness in the yarn or top is an important selling point. Also, predictability as to final product use is very limited to them. If they have an off-white product to sell, they must find a user whose needs can be met with a colored wool raw material. Often in the bargaining process, either a price concession for color will be made or the sale will be lost to another whose top or yarn is whiter, even if color is not necessarily a factor in its suitability for final product use of the buyer.

In the foregoing discussions of discounts and premiums for varying degrees of color in wool and the share of the total apparel product market eligible to each color level studied, each respondent's reply has been treated equally to arrive at the industry average. The firms visited, however, were very unequal in size and volume of wool processed. Selecting the largest firms in two of the groups, (1) worsted and woolen manufacturers with integrated processing facilities able to process grease wool into finished fabric within their own mills, and (2) large volume topmakers, whose combined wool processing operations are estimated by industry sources to take as much as one-half the total worsted apparel market wool, a different set of relationships is found for the importance of color in wool (table 3).

Two comments from processors provide a reason for the decrease in discounts as wool fiber diameter increases for topmakers and the contrary for integrated mills. Topmakers whose combed top is generally used for worsted construction have little demand for 1/4 blood wool tops. When made, the uses of 1/4 blood tops are those where color of the raw material is not very important. Also, it was said that more than likely a premium for color better than "C" will be asked if the topmaker makes an extra white top of the coarser grade wools.

On the other hand, mills making woolen fabrics for men's and women's outerwear for winter have been affected by a style trend toward nubby or pile-type materials of coarser wools, some using carpet and braid wools and carpet wool noils, thus putting a strong premium situation on whiter wools

Table 3.--Comparison of discount for color between large firms and with the industry average

Industry group	Discounts using color "A" as a base reference					
	Fine wool		Medium wool		1/4 blood wool	
	Color "C"	Color "E"	Color "C"	Color "E"	Color "C"	Color "E"
	Percent	Percent	Percent	Percent	Percent	Percent
Industry average	3.3	6.9	3.5	7.4	3.7	6.8
Major topmakers	2.2	5.3	1.7	4.0	0.7	1.7
Major integrated mills	2.8	6.4	4.2	8.5	9.0	9.7

in the coarser types. This is reflected in higher discounts for medium and coarse wool among woolen mills in the integrated mill group. This latter instance is a good example of the effect that trends in style can have on intra-commodity demand.

Capability to produce output requirements of the past year with the five levels of color shown by the comparator also showed differences between total responses and the responses of large firms of topmakers and large integrated mills (table 4).

Table 4.--Portion of total apparel wool products made in previous 12-months that could have been made with wools containing specified levels of color

Industry group	Average portion of total product that could be made using--				
	Color "A"	Color "B"	Color "C"	Color "D"	Color "E"
	Percent	Percent	Percent	Percent	Percent
All firms	91.1	73.7	56.9	35.5	32.6
Major topmakers	98.3	90.8	60.0	13.3	13.3
Major integrated mills	94.0	73.0	64.0	56.0	52.0

The sharp downward drop in use for color "D" and "E" by topmakers reflects the worsted systems view on highly colored wools. Major integrated mills can use more of the colored wools in woolen products and also by having integrated processing can control the placement of raw materials into their most suitable end-product uses. By this method of segregation, more colored wools can be used when the final product is a dark-dyed item.

COLOR IN RELATION TO OTHER QUALITY CHARACTERISTICS IN WOOL

Color's Rank of Importance as a Quality Factor

Respondents were asked to rank the importance of color in wool in relationship to other quality characteristics pertinent to processing quality. The quality characteristics for which rankings were sought were crimpiness, color, uniformity of fiber length, fineness (fiber diameter), black fiber, mechanical defects, and foreign matter. Shrinkage was not treated as a quality defect in this study. 3/

The question was asked of wool buyers in order to discover the quality features most important in a wool lot and the order of importance in which these characteristics are judged when decisions between offered lots have to be made.

Each quality factor is assumed to have a range of difference; for example, grades of wool rank in fineness from 80's to 36's and also within grades, such as fine wool with 80's, 70's, and 64's in the grade. In evaluation of the importance of each characteristic, the frame of reference was the full range of differences in one characteristic against the full range of differences of each other characteristic.

If this condition had not been assumed in evaluation of quality factor relationships, a case such as the choice of 62's wool instead of 64's on account of color, even though the finer wool was desired, would indicate color to be more important than fineness.

Fineness or wool fiber diameter ranked first (numerical average of all responses of 1.1) in buyer considerations. Uniformity of fiber length was ranked second by most buyers and had an average numerical ranking of 2.4. This was of importance mainly to worsted system uses where short fibers in nonuniform lots are removed as noils in the combing process. Foreign matter, color, black fiber, and mechanical defects all ranked third with average numerical rankings ranging from 3.2 to 3.8. Foreign matter ranked numerically as 3.2 on the average for all respondents, color and black fiber each drew an average numerical ranking of 3.3, and mechanical defects was ranked lowest of the 4 at 3.8. Crimpiness was disregarded altogether from ratings by many buyers. Its ranking as the seventh quality characteristic listed, with a numerical average of 4.9, by those who rated it was with less than half of the respondents giving it a separate consideration in the value judgment of wools.

3/ Although shrinkage is the major source of difference in price between raw wool and scoured wool and a judgment factor of primary importance to the producer and buyer of raw wool, the amount of shrinkage does not play an important part in determination of quality of wool for apparel uses. The other factors listed are characteristics of the wool after scouring and affect the processing and end use of the fiber.

When the firm's major products were both white or pastel-dyed products and dark-dyed products, separate rankings were requested of buyers for each class of products. The white and pastel-dyed product uses all had a high ranking, number 2 in most cases, for color. In a few, the noilage factor associated with uniformity of fiber length was ranked second after fiber diameter, but color was always ranked above the remaining quality characteristics listed.

It should be noted that these questions were asked without regard to source of the wool. The use of black-fiber-free wools was emphasized by many buyers for white and pastel-dyed products. After the source as a black-fiber-free area was taken into consideration, then color and the other factors were judged. The presence of black fiber in wools was considered of such importance that if the tolerance for it was exceeded, then no other factor was important because the wool would just not be bought for these uses. It might well be said from this that black or pigmented fiber content becomes the primary quality factor for wools intended for white and pastel-dyed apparel.

Color as an Indicator of Other Quality Characteristics

To some buyers, particularly those buying for topmaking and yarn making, color served as an indicator of other quality characteristics associated with it. The presence of color, particularly a high degree of color, is believed to indicate deterioration, loss of strength, increased harshness, or hidden foreign matter. These judgments, when choosing between lots of otherwise alike wools from the same producing area, will cause buyers to reject the more highly colored lot, even if the final use would be unaffected by the color itself. This opinion, however, was not shared by all in the business of buying wool for processing.

Quality characteristics of wool usually associated with a producing area are frequently judged on the basis of the color. Thus color becomes a key to the origin, when origin can be a valuable asset or when a hurried judgment for other factors is made. Domestic producing areas of the whiter wools tend to have more wool credited to them than is actually produced in them. Contrarily, off-white wools from these white wool areas may acquire identity with other producing areas, where the wool color is believed compatible in off-color, and other attributes are superior-valued in the user market. Market practices such as consumer purchases in "original bag" and by "grower's mark" have arisen largely to circumvent loss of identity.

These two points, that color is indicative of other basic quality characteristics of the fiber, and that it helps determine the origin of the wools must receive further investigation before their importance in these respects can be fully recognized.

EVALUATION OF COLOR BY GRADE AND USE OF WOOL

Examination of samples of wools reveals another facet of the color question relative to wool marketing.

Where samples of wools used in making the firm's products were available for comparison, the color comparator was used to associate these wools by grade, source, and type of wool product with the colors shown by the comparator. In each instance, the respondent was asked to show wools which were felt to meet the minimum color (highest degree of color that could be tolerated) requirement for his product.

Observations based on these tests of color of wools are as follows:

(1) As fineness decreases, firms can tolerate more color in the wools they use for the various products made.

(2) The least tolerance for color is in the finer grades (64's and up) that are used for worsted products.

(3) All foreign wools tested that were for uses in white and pastel-dyed products of worsted construction and for women's sweaters were above the top scale of whiteness shown by the comparator. Some were given ratings of "A plus 4," meaning a color equal to the level of whiteness 4 shades whiter than the whitest color shown by the comparator.

(4) Color value by the firm (each was asked to describe the color as "prime," "good," "fair," or "poor") tended to be associated with area or source. A "good" color for a wool from a fleece wool State would be rated lower, such as "fair," if it had come from a territory wool State.

(5) Colors shown by the comparator generally were "good" for colors "A" and "B," "fair" and "fair to good" generally fitted for "C" on the comparator scale. "Fair" also was used for colors in the range of "D" on the comparator scale when coarser wools of a source known for colored wools were considered. "E" color and "poor" rating for color were always matched regardless of grade or source.

(6) Colors of "A" and whiter were for lightly dyed worsted apparel and premium specialty products. "B" and "C" colors were found most frequently in uses for dyed woolens, for dyed knitting yarns, for blankets, military uniform goods, and dyed felts. Wools for dark-dyed worsted apparel goods, for men's and women's wear also had a color equal to "C" in a considerable proportion of the samples observed. Wools with color greater than "C" were all for uses in dark-dyed products, primarily woolen fabrics and knitting yarns.

(7) Area designation of color did not show up as a clearly delineated characteristic. Although taking area designations as groups showed more whiter wools from the areas usually associated with white wools, one or more wool samples observed from some other major producing areas or States gave color readings equal on the color scale to the wools from so-called white wool areas.

These observations of color in wools used by firms contacted were made on an "as found" basis and are not a sampling of the wools produced in the domestic areas nor an attempt to fix the market for colored wools in terms of applicable uses or the limits of uses of any particular wool, or color characteristic.

THE MARKET FOR DOMESTIC WOOL--ITS POTENTIAL AS AN OUTLET FOR COLORED WOOL

The Domestic Market

Generalization about the market for the clip as a whole cannot be made too accurately if the wool buying practices of individual firms are taken into account. Buyer preference for individual area wools, and processor practices of buying wool on a known-source basis, make the market activity of any one firm much more limited than the scope of grades, area designated wools, and color differences presented by the domestic clip when viewed as a whole. Thus a wool buyer who specializes in wools from a single source or area will not buy wools from other areas. Only a small number of wool buyers interviewed in the survey had experience and bought wool representative of the whole domestic clip. Specialization was the dominant practice among the wool buyers.

Specialization in buying wool is not an unnatural practice, since the processing industry is largely composed of firms having specialized products and processing equipment. Each processor naturally directs his buyer to concentrate on those wools that most ideally meet his processing requirements and that help create a reputation for products made from them. Even when the raw material used is a blend of wools from different sources to take advantage of the superior qualities of each, the raw materials by area source tend to be fixed in ratio, based upon consumer satisfaction with the resultant product.

Specialization by product among processors fixes the market for colored wools to those that are making a product unaffected by their use. Directing the flow of colored wools to market outlets wherein the presence of color is not a disadvantage offers the best opportunity of maximizing of potential usage within the specialized product marketing situation. Recognition of colored wools, segregation to uses where best suited and where they can competitively substitute for whiter wools can help prevent oversupply and disorderly marketing of a useful wool raw material.

Expanding the Market for Colored Wool Through Product or Market Adjustment

The apparel market and industrial nonapparel fabrics and felts are the primary outlets for wools of the domestic clip. Color is of little or no significance in the industrial uses, but good felting quality is and the best felting wools do not generally come from the producing areas where color defect is a frequently found quality-lowering characteristic.

The apparel market's requirements for wool considerably exceed domestic production. The marketability of domestic wools for apparel uses therefore depends, under existing tariffs on imported wools, on the preferences of buyers and processors between domestic and foreign wools. Packaging, color, black fiber, skirting, grading, sorting, and homogeneity of lots of the same description were subjects mentioned in reporting a preference for imported wools. Each mentioned subject indicates an opportunity for improvement that domestic wool producers and marketers may wish to consider.

The previous sections of this report have shown the industry's economic appraisal of the color problem. One approach to its solution is to develop color modifying agents to remove the color during processing. Bleaching is not wholly satisfactory, since the resultant product, although of improved whiteness, may be adversely affected by the bleach. For wool with color equal to "C" on the scale, the color-removing agent that does not damage other qualities of the fibers must cost no more than 3.5 percent of the market value of white wool. If the original color is that of "E," the margin for color improvement is approximately 7 percent of the market value of wool the whiteness of color "A."

An alternative to color removal is the segregated usage method of market disposal of colored wools. Trade practice currently accomplishes this and the discounting percentages determined by the survey are a reflection of the costs of marketing wools with different degrees of color. The opportunity to market colored wools depends upon the degree of color, since processor responses indicate the middle color "C" could be used in the year previous to this survey for an average of 56.9 percent of wool uses, whereas wool of color "E" could be placed in only 32.6 percent of total market usage.

If costs for modification of color by chemical means are equal to the discounts, neither of these methods of colored wool marketing or processing offers opportunity for larger relative returns to growers whose area, climatic and soil conditions, and husbandry practices cause their wool to be off-white. Each assumes the existent discounting for color a basis for (1) processing costs to whiten the wool, or (2) the added marketing cost for handling and placement in suitable uses. Color modification, however, offers possibilities for giving a broader marketing base to the whitened wool than is now realized since wool of color "A" was deemed suitable for 91.1 percent of industry usage.

A third alternative to market improvement for colored wool is the responsibility of the producer. If by improvement of breeding, husbandry practices, and handling and sorting of the clipped fleeces prior to shipment to central market, the grower can upgrade the wool in terms of its color, then the gains, if any, will accrue directly to him. This is the approach to the problem that has been used in other wool growing areas of the world. The incentive, reducing the effect of differentials for color, is only one of several benefits that have been derived from quality control efforts at this level of marketing. Improvements in packaging, sorting, and grading can also be achieved to make domestic wool more comparable with foreign wools in marketing form.

PART II

PHYSICAL MEASUREMENTS OF WOOL COLOR [4]

INTRODUCTION

One of the major problems associated with the economic measurement of color difference of wool was the establishment of a color scale appropriate for visual comparison. Such a scale was needed to provide a common basis for discussion of color between the interviewer and the wool processor.

In order to set up a visual color scale for wool it was first necessary to measure and define the color range that exists in clean scoured wool stock. For this purpose, instrumental color measurements were carried out on two groups of wool tops supplied by the U. S. Department of Agriculture Livestock Division Wool Laboratory (LDWL), Denver, Colo. The first group, processed in 1954, consisted of graded top samples from 46 lots chosen to represent the various wool growing areas in the United States. The second group, similarly chosen and processed in 1956, consisted of 42 graded samples representing 22 lots. Both unsorted and sorted samples were included. Tags, stained low ends, and black-gray-brown portions of fleece were removed from the sorted wools.

It is believed that these wools characterize the domestic clip in terms of color variation and that the measurements thus obtained were appropriate for development of the wool color comparator.

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[4] The work reported in this section was carried out at the Western Utilization Research and Development Division, Agricultural Research Service, Albany, Calif.

METHODOLOGY

The Gardner Automatic Color Difference Meter 5/ was adopted for instrumental measurement of wool color. This instrument expresses color in terms of three parameters (Hunter coordinates: R_d, which measures light reflectance or brightness; a, a numerical measure of redness when plus and greenness when minus; and b, a numerical measure of yellowness when plus and blueness when minus. White and neutral grays are characterized by zero values of a and b. This instrument has been used to advantage in developing the well-known Nickerson-Hunter Cotton Colorimeter 6/ as well as for other commercial color measurements.

The Color Difference Meter was standardized with a calibrated ivory-colored enameled iron plate (National Bureau of Standards, SKC-SBC-31). The calibrated values of this plate in Hunter units were as follows: $R_d = 57.0$, $a = 1.6$, and $b = 24.6$.

Color measurements were made on 10-gram samples of wool top. These were randomized by hand to minimize directional differences in reflectance caused by the parallel arrangement of fibers in top form. Instrument readings were obtained on the wool through the bottom end window in a 3" x 3" cylindrical glass cell. The wool was compressed with a 2 kg. weight to give reproducible packing between samples and between check readings. The results reported are averages of four separate measurements made on each sample of the variables R_d, a, and b. The sample was refluffed and repacked between each of the color difference measurements.

DATA AND OBSERVATIONS

The colorimetric measurements obtained on the LDWL wool top samples are shown in table 5. In addition to the color measurements, information on fineness, origin, year of clip, storage history, processing year, preparation of the wool, and the visual color rating by LDWL are included.

The data show that, in general, the finer wools were appreciably whiter than the coarser wools. Comparison of unsorted and sorted wools from the same lots (sample numbers 47 to 67) showed surprisingly small differences in reflectance or chromaticity.

The readings showed very little variation in the value of a (which was small and always negative, indicating a slight greenish hue) as compared with the variation in R_d and b. Accordingly, for the relatively small range found in these wool samples, the Hunter values R_d and b sufficed for determining the color differences of domestic wools.

5/ Mention of specific products in this report does not imply official endorsement.

6/ Nickerson, D. New Automatic Cotton Colorimeter for Use in Cotton Quality Specification, Textile Res. Jour. 21, 33 (1951).

Table 5.--Instrumental color measurements on Livestock Division Wool Laboratory wool top samples

Sample number	Grade of top	Origin of wool	Clip year	Where stored	Year processed	Preparation of wool		Visual color rating by LDWL 2/	Hunter color measurements			Color rating 3/
						Graded	Sorted 1/		R_d	a	b	
1	64's	Nev.	1952	Boston	1954	X		1	55.3	1.5	13.0	B
2	64's	N. Mex.	1952	Boston	1954	X		1	57.0	1.7	13.4	B
3	64's	Colo.	1952	Denver	1954	X		1	59.9	2.2	11.9	A
4	62's	S. Dak.	1952	Boston	1954	X		1	59.8	1.8	13.1	B
5	62's	S. Dak.	1952	Boston	1954	X		1	57.3	2.0	13.2	B
6	62's	Utah	1952	Boston	1954	X		2	56.1	1.6	13.7	C
7	62's	Wyo.	1952	St. Louis, Boston	1954	X		1	59.2	1.8	11.6	A
8	62's	Wyo.	1952	St. Louis, Boston	1954	X		1	58.4	2.1	12.2	A
9	62's	S. Dak.	1952	Boston	1954	X		1	57.0	1.8	12.6	B
10	62's	Mont.	1952	Boston	1954	X		1	57.2	1.6	12.5	B
11	60's	Wyo.	1952	Boston	1954	X		1	58.8	1.8	13.1	B
12	60's	Wyo.	1952	Boston	1954	X		1	55.6	1.9	13.0	B
13	60's	Mont.	1952	Boston	1954	X		1	59.0	2.0	14.3	C
14	60's	S. Dak.	1952	Boston	1954	X		1	56.8	2.0	13.8	B
15	58's	Utah	1952	St. Louis, Boston	1954	X		2	53.1	1.6	14.1	C
16	58's	Utah	1952	St. Louis, Boston	1954	X		2	55.4	1.4	13.8	C
17	58's	Idaho	1952	Boston	1954	X		1	55.6	2.2	13.3	B
18	58's	N. Mex.	1952	Boston	1954	X		1	57.3	2.0	12.8	B
19	58's	Mont.	1952	Boston	1954	X		1	55.7	2.0	13.0	B
20	58's	Idaho	1952	Boston	1954	X		2	52.0	2.1	13.5	C
21	58's	Mont.	1952	Boston	1954	X		2	55.0	2.2	14.9	C
22	56's	Idaho	1952	Boston	1954	X		1	56.2	2.1	13.2	B
23	56's	Colo.	1952	Denver	1954	X		2	54.0	2.0	13.8	C
24	54's	S. Dak.	1952	Boston	1954	X		3	49.0	1.7	15.5	D
25	54's	S. Dak.	1952	Boston	1954	X		3	51.8	1.8	15.1	D
26	54's	Minn.	1952	Boston	1954	X		3	52.4	1.8	13.5	C
27	54's	Minn.	1952	Boston	1954	X		2	52.3	1.9	14.6	C
28	54's	Mo.	1952	Kansas City	1954	X		3	51.5	1.6	17.0	E
29	54's	Wyo.	1952	Boston	1954	X		2	51.0	1.8	14.2	C
30	54's	Wyo.	1952	Boston	1954	X		2	54.9	2.0	13.5	B
31	54's	N. Dak., S. Dak., Minn.	1952	Boston	1954	X		3	48.8	1.9	15.5	D
32	50's	Va.	1952	Boston	1954	X		3	48.8	1.4	18.5	E
33	50's	Colo.	1952	Kansas City	1954	X		2	52.2	1.9	13.9	C
34	50's	Ky.	1952	Boston	1954	X		3	48.7	1.3	17.3	E
35	48's	Ill.	1952	Boston	1954	X		3	46.4	1.7	17.6	E
36	48's	Idaho, Wash., Oreg.	1951	Portland, Boston	1954	X		3	50.7	1.8	15.9	D
37	48's	Idaho, Wash., Oreg.	1952	Portland, Boston	1954	X		3	50.1	1.8	15.9	D
38	48's	Idaho	1952	Boston	1954	X		3	52.4	2.0	14.3	C
39	46's	Wis.	1952	Boston	1954	X		3	47.2	1.2	17.5	E

See footnotes at end of table.

Continued--

Table 5.--Instrumental color measurements on Livestock Division Wool Laboratory wool top samples--continued

Sample number	Grade of top	Origin of wool	Clip year	Where stored	Year processed	Preparation of wool		Visual color rating by LDWL [2]	Hunter color measurements			Color rating [3]
						Graded	Sorted [1]		R_d	a	b	
40	46's	Wis.	1952	Boston	1954	X		3	48.7	1.6	17.8	E
41	46's	Midwest area	1952	Boston	1954	X		3	47.8	1.7	17.3	E
42	46's	Idaho, Wash., Oreg.	1951	Portland, Boston	1954	X		3	48.7	1.8	15.8	D
43	46's	Oreg. Valley	1952	Portland	1954	X		3	47.9	1.4	18.2	E
44	46's	Oreg. Valley	1952	Portland	1954	X		3	49.8	1.4	18.6	E
45	44's	Oreg. Valley	1952	Portland	1954	X		3	43.1	1.5	18.0	E
46	40's	Oreg. Valley	1951	Portland, Boston	1954	X		3	47.0	1.5	17.9	E
47	64's	Calif.	1954	San Francisco	1956	X	X	2	56.8	1.3	14.2	C
47a	62's	Calif.	1954	San Francisco	1956	X		2	56.9	1.4	14.5	C
48	64's	Mich.	1954	Boston	1956	X	X	1	58.8	1.8	13.4	B
48a	64's	Mich.	1954	Boston	1956	X		1	59.5	1.8	13.4	B
49	64's	Calif.	1954	San Francisco	1956	X	X	2	55.4	2.0	13.4	B
49a	62's	Calif.	1954	San Francisco	1956	X		2	56.4	2.2	13.2	B
50	70's	Tex.	1954	San Angelo	1956	[4]X	X	1	61.7	2.3	12.1	A
50a	70's	Tex.	1954	San Angelo	1956	[4]X		1	61.1	2.4	11.6	A
51	64's	Tex.	1954	San Angelo	1956	[4]X	X	1	62.4	2.3	12.9	A
51a	64's	Tex.	1954	San Angelo	1956	[4]X		1	63.6	2.3	13.0	B
52	64's	Tex.	1954	San Angelo	1956	[4]X	X	1	62.7	2.2	12.8	A
52a	[5]64's	Tex.	1954	San Angelo	1956	[4]X		1	62.9	2.1	12.7	A
53	[5]60's	Calif.	1954	San Francisco	1956	X	X	3	52.7	1.1	13.5	C
53a	60's	Calif.	1954	San Francisco	1956	X		3	54.8	1.2	13.7	B
54	60's	Idaho	1953	Denver	1956	X	X	1	58.5	2.4	12.0	A
54a	60's	Idaho	1953	Denver	1956	X		1	61.1	2.5	12.3	A
55	62's	Nev.	1954	Boston	1956	X	X	2	53.2	1.6	14.0	C
55a	62's	Nev.	1954	Boston	1956	X		2	54.3	1.9	13.5	C
56	58's	S. Dak.	1954	Boston	1956	X	X	1	60.2	2.5	11.2	A
56a	58's	S. Dak.	1954	Boston	1956	X		1	63.5	2.5	11.8	A
57	[5]58's	Calif.	1954	Boston	1956	X	X	2	51.9	1.8	14.9	C
57a	[5]58's	Calif.	1954	Boston	1956	X		2	53.8	1.7	14.8	C
58	56's	Colo.	1954	Boston	1956	X	X	1	57.2	2.1	12.2	B
58a	54's	Colo.	1954	Boston	1956	X		1	56.0	2.2	11.9	A
59	56's	Idaho	1954	Boston	1956	X	X	2	57.1	2.1	13.4	B
59a	58's	Idaho	1954	Boston	1956	X		2	54.5	2.0	12.5	B
60	56's	N. Y.	1954	Boston	1956	X	X	3	49.7	1.4	17.3	E
60a	54's	N. Y.	1954	Boston	1956	X		3	49.4	1.3	17.4	E
61	[5]54's	Wyo.	1954	Boston	1956	X	X	2	55.6	2.3	12.3	B
61a	[5]50's	Wyo.	1954	Boston	1956	X		2	55.7	2.4	12.2	B

See footnotes at end of table.

Continued--

Table 5.--Instrumental color measurements on Livestock Division Wool Laboratory wool top samples--continued

Sample number	Grade of top	Origin of wool	Clip year	Where stored	Year processed	Preparation of wool		Visual color rating by LDWL [2]	Hunter color measurements			Color rating [3]
						Graded	Sorted [1]		R_d	a	b	
62	[5]50's	N. Y.	1954	Boston	1956	X	X	3	51.6	1.5	16.6	D
62a	[5]48's	N. Y.	1954	Boston	1956	X		3	50.1	1.4	17.2	E
63	[5]50's	N. Y.	1954	Boston	1956	X	X	3	49.7	1.4	17.8	E
63a	[5]50's	N. Y.	1954	Boston	1956	X		3	48.6	1.2	18.4	E
64	[5]48's	Idaho	1952	Denver	1956	X	X	2	53.5	1.8	14.5	C
64a	[5]48's	Idaho	1952	Denver	1956	X		2	51.7	1.8	14.8	C
65	[5]46's	N. Y.	1954	Boston	1956	X	X	3	50.2	1.5	17.6	E
65a	[5]46's	N. Y.	1954	Boston	1956	X		3	51.7	1.6	16.8	D
66	[5]46's	Va.	1954	Boston	1956	X	X	3	51.4	1.8	17.5	E
66a	44's	Va.	1954	Boston	1956	X		3	49.6	1.6	17.2	E
67	[5]48's	Calif.	1953	San Francisco	1956	X	X	3	50.6	1.8	17.8	E
67a	[5]48's	Calif.	1953	San Francisco	1956	X		3	49.1	1.8	17.8	E

[1] Tags, stained, low ends and black-gray-brown removed.
[2] Livestock Division Wool Laboratory visual rating for whiteness: 1 = whitest; 2 = next best; 3 = least white.
[3] The color rating here is defined by W values from the Hunter color data. (See text.)
[4] Original bag wool.
[5] Estimated grade.

The color relationships are graphically shown in figure 3 as a 2-dimensional plot in Hunter coordinates. On this diagram the ordinates are R_d values and the abscissas $\underline{b}$ values. Different symbols (+, o, or x) are used to indicate the visual ratings assigned by the LDWL.

This color plot shows that the range of color in domestic wools constitutes a fairly narrow band sloping from the upper left corner for the whiter wools (high R_d, low $\underline{b}$) to the lower right for the yellower wools (low R_d, high $\underline{b}$). There are no typically gray wools (low R_d, low $\underline{b}$) in the entire group, so that in the development of a color scale for visual comparison, it was found unnecessary at this stage to consider an independent grayness coordinate.

DEVELOPMENT OF WOOL COLOR COMPARATOR

Visual estimation of color is a complex psychological process. The observer combines impressions of chromaticity and brightness in arriving at a single estimate of relative color. Before instrumental measurement of wool color could be used as a rational basis for specifying color, it was necessary first to relate the 3-dimensional instrumental results to visual judgments of relative whiteness or yellowness and second to divide the range of values into areas such that samples lying at opposite limits of each area differ by comparable perceptible amounts. Fortunately, this task was made simpler by facts already noted. First, the Hunter $\underline{a}$ values were sufficiently constant and small that they could be omitted from further consideration. Second, changes in brightness and yellowness were so closely related that the range was sufficiently well defined by a single color scale.

For this purpose, Judd's equation [7/] for assigning numerical values to the whiteness of near-white objects was modified (by expressing lightness and chromaticity in Hunter units and neglecting the $\underline{a}$ value) to give the following expression:

$$W = 1 - \left\{\underline{b}^2/1000 - \left(1 - (R_d/100)^{\frac{1}{2}}\right)^2\right\}^{\frac{1}{2}}$$

In this relationship, W is a measure of relative whiteness, being 1.00 for the white standard and zero for black. Because of the relatively small range of observed wool color and the close relation of yellowness and reflectance (R_d), the expression of color in terms of the single value, W, correlates well with ranking based upon visual estimates of whiteness. The calculated W value therefore was adopted as a reasonable basis for dividing the R_d vs. $\underline{b}$ color diagram of figure 3 into 5 distinguishable, regularly spaced color regions. These regions are defined as follows:

[7/] Judd, D. B. Color in Business, Science, and Industry. Wiley & Sons, New York, 1952.

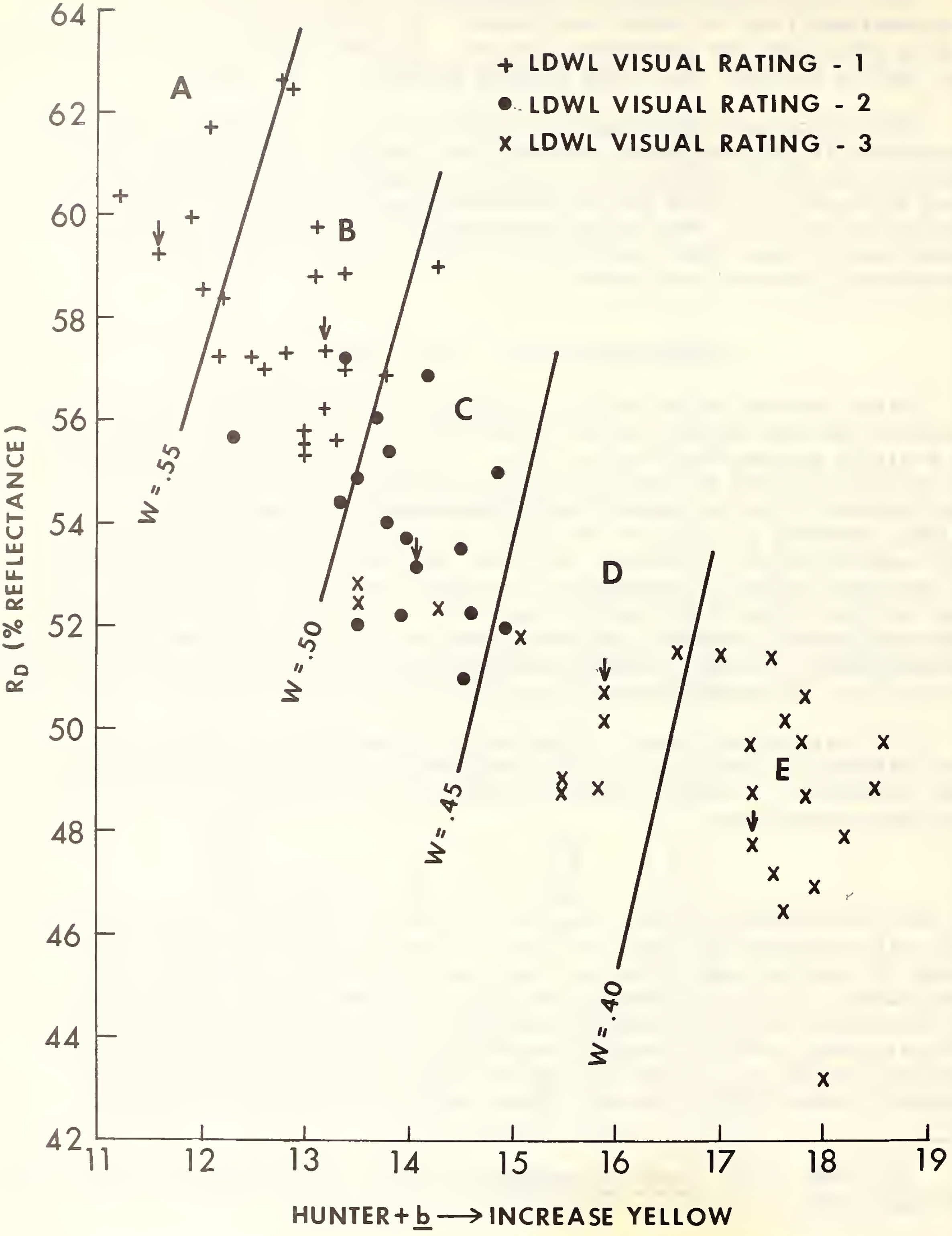

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Figure 3

Color region	W value
A	Above 0.55
B	0.50 - 0.55
C	0.45 - 0.50
D	0.40 - 0.45
E	Below 0.40

The boundaries of these color regions are indicated on figure 3 by the oblique lines along the loci of points for W equal to 0.55, 0.50, 0.45, and 0.40, respectively. It is of interest to note that most of the samples visually rated 1 (whitest) by the Livestock Division Wool Laboratory fell into regions A and B, those rated 2 into region C, and those rated 3 into regions D and E.

In a first attempt to establish color standards for use in a visual wool color comparator, five samples (LDWL samples numbers 7, 5, 15, 36, and 39, located in regions A, B, C, D, and E, respectively, as indicated by the arrows in fig. 3) were selected as tentative standards. In considering the use of these samples for judging the color, they were exposed to northern light through a window for about 2 weeks. In this short time the color of the yellower wools faded (lightened in color) to an extent that they were considered unsuitable for use as standards.

In view of this color instability, specimens of a single lot of white wool top were specially dyed so that their measured R_d, a, and b values placed them in the centers of color regions B, C, D, and E. Undyed LDWL sample number 7 was retained as the standard for color region A because of the difficulty of obtaining a comparable dyed sample.

A combination of three dyes, Calcofast Yellow 2G, Calcofast Olive Brown B, and Calcofast Gray G, in approximately equal concentrations, was used to obtain the desired color shade. 8/ These dyes are of the acid dyeing premetallized type. They were selected because of their reported good fastness towards light. The manufacturer's recommended dyeing procedure for this type of dyestuff was followed.

The dye concentrations required to obtain suitable samples for tentative standards together with the corresponding Hunter color values are summarized below. It is interesting to note that although the colors of the dyed samples were exactly comparable to those of normal wools, they were readily distinguished by an experienced observer because of their greater uniformity of coloring matter.

8/ Products are named for technical information only, and mention does not imply an official endorsement of these over other dye products of like properties.

Color region	Dye concentration (percentage on weight of wool) Calcofast yellow 2G	Calcofast olive brown B	Calcofast gray G	Hunter color measurement R_d	a	b
A 1/	---	---	---	59.2	-1.8	11.6
B	0.00112	0.00112	0.00105	57.8	-3.2	13.0
C	0.00374	0.00374	0.00300	54.3	-2.8	14.6
D	0.00653	0.00653	0.00525	49.4	-2.7	15.7
E	0.0131	0.0131	0.00875	47.5	-1.5	18.0

1/ Undyed--LDWL sample number 7.

In order to assist visual comparison of wool samples with the tentative standards defined in this way, a wool color comparator (fig. 1) was constructed. This consisted of a rectangular box made of Lucite with a color-clear plate glass viewing face. The upper half of the comparator was divided into 5 small rectangular compartments containing the tentative standards, A, B, C, D, and E. A 2-gram sample of each of these was compressed against the glass viewing face with a rectangular block to insure uniform packing. The test sample (approximately 10 grams) was put in the lower test compartment running the full width of the comparator. The wool was compressed against the glass viewing face with a plastic plate for comparison with the color standards. Assignment of color class was then made by visual judgment.

For the purpose of this economic study, the wool color comparator was fully adequate. However, these refinements may be desirable in the development of permanent wool standards for commercial use: (1) the constant (1,000) used in our modified Judd equation may be changed to assure that the lines of constant calculated whiteness define color regions within which the range of visual differences is at a minimum; (2) the spacings of these regions may be subjected to psychological test to assure that they are representative of comparable perceptual differences; (3) it would be desirable to base color qualifications for wool on measurements of a greater number and more variated group of wool samples; (4) additional color regions are needed to differentiate classes of whiter natural and bleached wools; and (5) since even the dyed wool samples used as standards in this study are changed by exposure for a long time, it is important that samples used for color comparison be checked at reasonable intervals for color accuracy by a color difference meter such as used in this study.

APPENDIX

Colored Wool in the Domestic Wool Clip

Ninety-seven percent of the total 1946 domestic wool clip of 280 million pounds, grease basis, was purchased by the Commodity Credit Corporation under the commodity loan program. The classification as to grade, staple length, shrinkage, and other factors (of which color and color combined with other factors were judged separately) was made by an appraisal committee comprised of experienced wool men.

Approximately 33 million pounds, or 12.5 percent, of the grease wool, exclusive of off-wools, were discounted in price. Color, color and defect (burrs, seed, etc.), and color and other (not defect) discount classifications accounted for only about 1 percent (336,685 pounds) of the total greasy wool purchased. California, Utah, and Texas had approximately half of the discounted wool in these classifications, the other half was from fleece wool States and Southern wool States.

Scoured wool purchased by Commodity Credit Corporation was much more heavily discounted for color factors. Of 4,652,176 pounds purchased at discounts, 3,299,382 pounds were discounted for color, color and defect, and color and other (not defect). The Western States had 1,869,629 pounds discounted for these factors, Texas had 674,845 pounds discounted for these reasons, and all other States had 600,255 pounds discounted. Texas and New Mexico scoured wools were more heavily discounted for burrs and other defects, than for color. In the scoured wools from other States, color was a major cause of discounts.

That color was the major source of discounting in scoured wool lots purchased by Commodity Credit Corporation is an indication of the problem of color evaluation in greasy wool. Lots which were problematical to graders for shrinkage, poor appearance or from the standpoint of color removal by scouring were accepted only after they had been scoured.

On the basis of findings by graders of the 1946 wool clip, color was a source of discounting for 832,871 pounds, clean basis. The average discount was 3.43 cents per pound, clean basis.

Color and defect combined caused 1,920,821 pounds, clean basis, to be discounted. The average discount, clean basis, was 8.30 cents per pound.

Color and other (not defect) caused 679,244 pounds, clean basis, to be discounted an average of 6.05 cents per pound.

Table 6.--Volume of discounted shorn greasy and scoured wool purchased by Commodity Credit Corporation, by kind and amount of discounts, and appraised value of discounted purchases, United States, and by States, clip of 1946 1/

Type of discount by area	Grease wool purchased					Scoured wool purchased			
	Quantity discounted	Amount of discount			Appraisal value of wool discounted	Quantity discounted	Amount of discount		Appraisal value of wool discounted
		Per pound		Total			Per clean pound	Total	
		Grease basis	Clean basis						
	Pounds	Cents	Cents	Dollars	Dollars	Pounds	Cents	Dollars	Dollars
United States:									
Color	171,914	1.12	2.10	1,920	89,771	736,282	3.60	26,516	817,132
Defect and color	100,943	2.43	5.96	2,452	45,912	1,879,671	8.35	157,018	1,893,734
Color and other (not defect)	63,828	.63	1.59	403	29,029	653,916	6.22	40,127	685,777
Total	336,685	---	---	4,775	164,712	3,269,869	---	223,661	3,396,643
Alaska and Hawaii	---	---	---	---	---	29,513	---	2,484	30,369
Grand total	336,685	---	---	4,775	164,712	3,299,382	---	226,145	3,427,012
Arizona:									
Color	---	---	---	---	---	8,455	3.0	250	9,643
Defect and color	---	---	---	---	---	19,576	10.0	1,967	19,782
Color and other (not defect)	---	---	---	---	---	3,287	30.3	996	2,580
Total	---	---	---	---	---	31,318	---	3,213	32,005
California:									
Color	---	---	---	---	---	543,137	3.9	21,415	606,751
Defect and color	53,248	1.2	3.0	640	24,370	777,658	8.4	65,532	763,953
Color and other (not defect)	2,396	3.4	7.0	80	1,271	422,822	5.1	21,572	457,412
Total	55,644	---	---	720	25,641	1,743,617	---	108,519	1,828,116
Colorado:									
Color	---	---	---	---	---	1,846	2.0	38	1,928
Defect and color	---	---	---	---	---	1,562	19.1	298	1,323
Color and other (not defect)	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	3,408	---	336	3,251
Idaho:									
Color	---	---	---	---	---	4,401	2.6	116	4,869
Defect and color	---	---	---	---	---	5,659	13.6	772	5,354
Color and other (not defect)	---	---	---	---	---	1,007	7.7	77	1,040
Total	---	---	---	---	---	11,067	---	965	11,263
Montana:									
Color	---	---	---	---	---	---	---	---	---
Defect and color	---	---	---	---	---	32,297	6.9	2,221	33,971
Color and other (not defect)	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	32,297	---	2,221	33,971

See footnote at end of table.

Continued--

Table 6.--Volume of discounted shorn greasy and scoured wool purchased by Commodity Credit Corporation, by kind and amount of discounts, and appraised value of discounted purchases, United States, and by States, clip of 1946 1/--continued

Type of discount by area	Grease wool purchased					Scoured wool purchased			
	Quantity discounted	Amount of discount			Appraisal value of wool discounted	Quantity discounted	Amount of discount		Appraisal value of wool discounted
		Per pound		Total			Per clean pound	Total	
		Grease basis	Clean basis						
	Pounds	Cents	Cents	Dollars	Dollars	Pounds	Cents	Dollars	Dollars
Nevada:									
Color	---	---	---	---	---	---	---	---	---
Defect and color	---	---	---	---	---	---	---	---	---
Color and other (not defect)	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	---	---	---	---
New Mexico:									
Color	---	---	---	---	---	5,209	4.0	211	5,827
Defect and color	4,885	.9	2.3	45	2,146	2,053	8.5	174	2,067
Color and other (not defect)	---	---	---	---	---	5,498	32.5	1,789	4,414
Total	4,885	---	---	45	2,146	12,760	---	2,174	12,308
Oregon:									
Color	---	---	---	---	---	3,952	5.0	197	4,110
Defect and color	---	---	---	---	---	---	---	---	---
Color and other (not defect)	---	---	---	---	---	4,108	8.0	329	3,492
Total	---	---	---	---	---	8,060	---	526	7,602
Utah:									
Color	---	---	---	---	---	368	2.0	7	386
Defect and color	---	---	---	---	---	---	---	---	---
Color and other (not defect)	59,962	.4	1.0	234	27,085	60	8.7	5	52
Total	59,962	---	---	234	27,085	428	---	12	438
Washington:									
Color	---	---	---	---	---	3,184	2.0	64	3,287
Defect and color	---	---	---	---	---	476	20.8	99	410
Color and other (not defect)	---	---	---	---	---	9,817	3.7	361	10,210
Total	---	---	---	---	---	13,477	---	524	13,907
Wyoming:									
Color	---	---	---	---	---	---	---	---	---
Defect and color	---	---	---	---	---	13,196	11.3	1,487	14,665
Color and other (not defect)	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	13,196	---	1,487	14,665
Western States:									
Color	---	---	---	---	---	570,552	---	22,298	636,801
Defect and color	58,133	---	---	685	26,516	852,477	---	72,550	841,525
Color and other (not defect)	62,358	---	---	314	28,356	446,599	---	25,129	479,200
Total	120,491	---	---	999	54,872	1,869,628	---	119,977	1,957,526

See footnote at end of table.

Continued--

Table 6.--Volume of discounted shorn greasy and scoured wool purchased by Commodity Credit Corporation, by kind and amount of discounts, and appraised value of discounted purchases, United States, and by States, clip of 1946 1/--continued

Type of discount by area	Grease wool purchased					Scoured wool purchased			
	Quantity discounted	Amount of discount			Appraisal value of wool discounted	Quantity discounted	Amount of discount		Appraisal value of wool discounted
		Per pound		Total			Per clean pound	Total	
		Grease basis	Clean basis						
	Pounds	Cents	Cents	Dollars	Dollars	Pounds	Cents	Dollars	Dollars
Arkansas:									
Color	---	---	---	---	---	---	---	---	---
Defect and color	---	---	---	---	---	---	---	---	---
Color and other (not defect)	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	---	---	---	---
Illinois:									
Color	---	---	---	---	---	1,689	1.0	17	1,892
Defect and color	---	---	---	---	---	28,913	4.0	1,169	31,086
Color and other (not defect)	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	30,602	---	1,186	32,978
Indiana:									
Color	1,287	1.1	2.0	14	678	5,245	2.1	109	5,448
Defect and color	---	---	---	---	---	19,163	4.8	913	20,981
Color and other (not defect)	---	---	---	---	---	567	4.0	23	567
Total	1,287	---	---	14	678	24,975	---	1,045	26,996
Iowa:									
Color	---	---	---	---	---	14,380	2.1	298	15,872
Defect and color	---	---	---	---	---	50,690	4.3	2,162	55,202
Color and other (not defect)	---	---	---	---	---	4,731	10.0	472	4,831
Total	---	---	---	---	---	69,801	---	2,932	75,905
Kansas:									
Color	---	---	---	---	---	---	---	---	---
Defect and color	---	---	---	---	---	2,960	4.6	137	3,215
Color and other (not defect)	---	---	---	---	---	1,153	20.0	231	1,237
Total	---	---	---	---	---	4,113	---	368	4,452
Kentucky:									
Color	3,397	1.2	2.0	39	1,909	---	---	---	---
Defect and color	978	.9	2.0	9	475	4,886	10.0	489	4,495
Color and other (not defect)	---	---	---	---	---	---	---	---	---
Total	4,375	---	---	48	2,384	4,886	---	489	4,495
Michigan:									
Color	---	---	---	---	---	---	---	---	---
Defect and color	---	---	---	---	---	15,710	3.5	544	16,751
Color and other (not defect)	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	15,710	---	544	16,751

See footnote at end of table.

Continued--

Table 6.--Volume of discounted shorn greasy and scoured wool purchased by Commodity Credit Corporation, by kind and amount of discounts, and appraised value of discounted purchases, United States, and by States, clip of 1946 1/--continued

Type of discount by area	Grease wool purchased					Scoured wool purchased			
	Quantity discounted	Amount of discount			Appraisal value of wool discounted	Quantity discounted	Amount of discount		Appraisal value of wool discounted
		Per pound		Total			Per clean pound	Total	
		Grease basis	Clean basis						
	Pounds	Cents	Cents	Dollars	Dollars	Pounds	Cents	Dollars	Dollars
Minnesota:									
Color	---	---	---	---	---	14,185	1.6	224	15,178
Defect and color	---	---	---	---	---	21,235	7.8	1,646	21,916
Color and other (not defect)	---	---	---	---	---	2,999	9.0	270	2,969
Total	---	---	---	---	---	38,419	---	2,140	40,063
Missouri:									
Color	---	---	---	---	---	3,662	4.7	174	3,780
Defect and color	---	---	---	---	---	20,027	5.7	1,135	20,506
Color and other (not defect)	---	---	---	---	---	19,518	4.2	827	19,783
Total	---	---	---	---	---	43,207	---	2,136	44,069
Nebraska:									
Color	---	---	---	---	---	192	1.0	2	200
Defect and color	---	---	---	---	---	36,454	6.9	2,402	38,246
Color and other (not defect)	---	---	---	---	---	5,173	5.6	288	5,454
Total	---	---	---	---	---	41,819	---	2,692	43,900
New York:									
Color	---	---	---	---	---	5,186	3.0	157	5,277
Defect and color	---	---	---	---	---	5,728	5.2	301	6,093
Color and other (not defect)	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	10,914	---	458	11,370
North Dakota:									
Color	4,908	3.3	10.0	162	1,749	9,554	2.6	253	10,410
Defect and color	---	---	---	---	---	8,607	12.1	1,038	8,299
Color and other (not defect)	---	---	---	---	---	---	---	---	---
Total	4,908	---	---	162	1,749	18,161	---	1,291	18,709
Ohio:									
Color	---	---	---	---	---	1,673	1.0	17	1,823
Defect and color	---	---	---	---	---	29,450	4.3	1,263	31,622
Color and other (not defect)	---	---	---	---	---	2,566	7.1	183	2,725
Total	---	---	---	---	---	33,689	---	1,463	36,170
Oklahoma:									
Color	66,726	.5	1.0	329	33,563	1,770	5.0	88	2,000
Defect and color	---	---	---	---	---	157	18.3	29	147
Color and other (not defect)	---	---	---	---	---	32	13.0	4	29
Total	66,726	---	---	329	33,563	1,959	---	121	2,176

See footnote at end of table.

Continued--

Table 6.--Volume of discounted shorn greasy and scoured wool purchased by Commodity Credit Corporation, by kind and amount of discounts, and appraised value of discounted purchases, United States, and by States, clip of 1946 1/--continued

Type of discount by area	Grease wool purchased					Scoured wool purchased			
	Quantity discounted	Amount of discount			Appraisal value of wool discounted	Quantity discounted	Amount of discount		Appraisal value of wool discounted
		Per pound		Total			Per clean pound	Total	
		Grease basis	Clean basis						
	Pounds	Cents	Cents	Dollars	Dollars	Pounds	Cents	Dollars	Dollars
Pennsylvania:									
Color	4,433	1.7	3.0	73	2,344	---	---	---	---
Defect and color	---	---	---	---	---	---	---	---	---
Color and other (not defect)	---	---	---	---	---	---	---	---	---
Total	4,433	---	---	73	2,344	---	---	---	---
South Dakota:									
Color	---	---	---	---	---	32,150	2.5	799	35,416
Defect and color	---	---	---	---	---	87,727	5.1	4,485	92,172
Color and other (not defect)	---	---	---	---	---	14,205	8.5	1,205	14,284
Total	---	---	---	---	---	134,082	---	6,489	141,872
Tennessee:									
Color	18,721	.6	1.0	106	10,885	---	---	---	---
Defect and color	---	---	---	---	---	---	---	---	---
Color and other (not defect)	1,035	6.2	10.0	64	481	---	---	---	---
Total	19,756	---	---	170	11,366	---	---	---	---
Virginia:									
Color	1,567	5.3	12.0	82	655	---	---	---	---
Defect and color	---	---	---	---	---	---	---	---	---
Color and other (not defect)	148	6.8	12.0	10	67	---	---	---	---
Total	1,715	---	---	92	722	---	---	---	---
West Virginia:									
Color	569	12.7	23.4	72	235	26,492	2.2	591	28,646
Defect and color	---	---	---	---	---	3,164	7.2	227	3,277
Color and other (not defect)	47	6.0	10.0	3	21	3,238	11.3	365	3,002
Total	616	---	---	75	256	32,894	---	1,183	34,925
Wisconsin:									
Color	---	---	---	---	---	467	2.0	9	495
Defect and color	---	---	---	---	---	32,685	3.3	1,063	35,146
Color and other (not defect)	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	33,152	---	1,072	35,641
Louisiana and Mississippi:									
Color	---	---	---	---	---	1,872	10.0	187	1,666
Defect and color	---	---	---	---	---	890	20.0	178	703
Color and other (not defect)	90	3.1	7.0	3	42	59,110	6.0	3,542	57,454
Total	90	---	---	3	42	61,872	---	3,907	59,823

See footnote at end of table.

Continued--

Table 6.--Volume of discounted shorn greasy and scoured wool purchased by Commodity Credit Corporation, by kind and amount of discounts, and appraised value of discounted purchases, United States, and by States, clip of 1946 1/--continued

Type of discount by area	Grease wool purchased					Scoured wool purchased			
	Quantity discounted	Amount of discount			Appraisal value of wool discounted	Quantity discounted	Amount of discount		Appraisal value of wool discounted
		Per pound		Total			Per clean pound	Total	
		Grease basis	Clean basis						
	Pounds	Cents	Cents	Dollars	Dollars	Pounds	Cents	Dollars	Dollars
Maine, Massachusetts, New Hampshire, New Jersey, Vermont:									
Color	---	---	---	---	---	---	---	---	---
Defect and color	---	---	---	---	---	---	---	---	---
Color and other (not defect)	---	---	---	---	---	---	---	---	---
Total	---	---	---	---	---	---	---	---	---
Maryland and North Carolina:									
Color	6,251	2.7	5.0	168	3,206	---	---	---	---
Defect and color	---	---	---	---	---	---	---	---	---
Color and other (not defect)	---	---	---	---	---	---	---	---	---
Total	6,251	---	---	168	3,206	---	---	---	---
All States except Texas and Western States:									
Color	107,859	---	---	1,045	55,224	118,517	---	2,925	128,103
Defect and color	978	---	---	9	475	368,446	---	19,181	389,857
Color and other (not defect)	1,320	---	---	80	611	113,292	---	7,410	112,335
Total	110,157	---	---	1,134	56,310	600,255	---	29,516	630,295
Texas:									
Color	8,009	2.6	4.9	210	4,073	41,702	2.8	1,173	46,251
Defect and color	41,832	4.2	10.2	1,758	18,921	625,060	10.1	63,357	625,774
Color and other (not defect)	150	6.0	15.0	9	62	8,083	15.6	1,260	7,626
Total	49,991	---	---	1,977	23,056	674,845	---	65,790	679,651
Fleece type or area--State of origin unknown:									
Color	56,046	1.2	2.0	665	30,474	5,511	2.2	120	5,977
Defect and color	---	---	---	---	---	28,720	5.6	1,594	30,915
Color and other (not defect)	---	---	---	---	---	84,933	7.2	6,077	85,778
Total	56,046	---	---	665	30,474	119,164	---	7,791	122,670
Territory type or area--State of origin unknown:									
Color	---	---	---	---	---	---	---	---	---
Defect and color	---	---	---	---	---	4,968	6.8	336	5,663
Color and other (not defect)	---	---	---	---	---	1,009	24.9	251	838
Total	---	---	---	---	---	5,977	---	587	6,501

1/ Graded and original bag grease wools were appraised under grade and length classification in the purchase price schedule and discounted because the wools were shorn from feed lot sheep.

Data for this table are from table 8, pp. 83-96, "The Domestic Wool Clip," Livestock Branch, U. S. Dept. Agr., June 1951.

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